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AN EFFICIENT LIQUID DISINFECTANT.

A FORMULA BY WHICH ONE CAN BE READILY PREPARED.

By ALBERT F. STEVENSON, Sanitary Chemist, Hygienic Laboratory, United States Public Health Service.

The modern health officer and sanitarian, in his war upon contagious disease, is becoming convinced of the advisability of the free use of liquid disinfectants. He not only finds it desirable to disinfect articles which have come into intimate contact with infectious material but frequently recommends the rather free use of disinfectants in the household and in the schoolroom and other public places.

Of the various disinfecting substances that might be used for such purposes, emulsified organic compounds, and especially the coal-tar products, have come into most general use. They are noncorrosive, are relatively nontoxic, and, by reason of their soapy nature, are admirably fitted for general cleansing purposes. A large number of these products have been put upon the market in recent years as proprietary articles with trade names that give but little clue to their nature or efficiency. The better ones have a guaranteed "phenol coefficient," thus placing a definite legal responsibility upon the manufacturer. Many manufacturers avoid this liability, either through ignorance of its importance or unwillingness to state the true facts. The public health official and the householder are often at a loss, therefore, to select a disinfectant which will be at the same time efficient and economical. This doubt has prompted many inquiries addressed to the United States Public Health Service as to the merits of various market preparations and the selection of the most efficient one upon the basis of cost. The matter has become one of sufficient importance to justify an investigation on the part of the Public Health Service looking toward the preparation of a disinfectant that should be efficient, cheap, and readily compounded of materials obtainable upon the market.

The report [1] of Anderson and McClintic which showed the worthless character of many of the so-called disinfectants upon the market at that time, is of little value for present purposes since new preparations are constantly appearing and there is no assurance of the constancy of any particular trade material.

A number of substances have been investigated and a full report of the investigation will be issued shortly as a bulletin of the Hygienic Laboratory. The final results of these studies are given in the present report.

The preparation which is recommended is made from "pine oil," manufactured by the "steam or solvent" process, and emulsified with saponified rosin, according to a definite procedure. It has a hygienic laboratory phenol coefficient of between 4 and 6. The method of preparation is simple and can be carried out without special apparatus.

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[1] United States Public Health Service, Hygienic Laboratory Bulletin No. 82, 1912.

Description of Ingredients Used.

Pine oil.—Pine oil is a general term given to certain fractions from both the "destructive distillation" and the "steam or solvent" process, for the recovery of turpentine from waste wood of the long-leaf southern pine. For the purpose of compounding this disinfectant, pine oils from these two processes must not be confused. It is only the oil from the "steam or solvent" process which can be used.

Pine oil is probably a mixture of many essential oils of the terpinol family. It is a by-product from the manufacture of wood turpentine, and probably is the substance which prevents the decay of "pitch pine" stumps. It is an amber-colored liquid, having the characteristic odor of pine wood, and should be perfectly clear, transparent, and free from any considerable sediment.

The commercial product contains from 3 to 4 per cent of dissolved water. When freed from this water, the oil should commence to distill at not less than 207° C., and approximately 85 per cent of it should distill between 207° C. and 230° C.

The pine oil should be freshly distilled when purchased. This is very important. It has been found that its germicidal power deteriorates on standing. The germicidal power of an old oil may be brought back to its original degree by redistilling.

Pine oil, as described here, can be purchased from concerns manufacturing wood turpentine by the "steam or solvent" process.

Rosin.—The rosin used in the emulsification is "Good, strained North Carolina, Grade E." This rosin is rather dark in color and is sold in lumps. It is not wholly free from dirt and other foreign matter. The dirt settles out quickly and does not interfere in any way with the finished product. The rosin should be broken into small pieces to hasten the solution in the oil.

Sodium hydroxid solution (NaOH).—This solution is used to form a soap with the rosin. It has been found that 25 per cent of sodium hydroxid (NaOH), by weight, is the most efficient concentration for use in this work. The solution is made from commercial "lye" or sodium hydroxid. The manufacturers assay, or the per cent NaOH in the alkali, may be correct, but it is safe to assume a strength 2 per cent less than the statement on the label. An alkali solution slightly in excess of 25 per cent makes no material difference in the finished disinfectant, but too little active alkali is fatal to the emulsion.

When sodium hydroxid is dissolved in water, considerable heat is generated, and the solution is corrosive and violently attacks the hands and clothing. The lye should be weighed quickly to avoid the absorption of moisture, placed either in a wooden or an enameled iron pail, and the necessary water added. After stirring, cover the pail to prevent evaporation during cooling. When cold, the solution can be stored in glass containers and stoppered with tightly fitting rubber stoppers.

The following table will be of use in the computation of the crude alkali necessary to make the desired solution:

Assay of alkali, per cent NaOH.	Metric units.		Avoirdupois.	
	Alkali.	Water.	Alkali.	Water (by weight).
	Grams.	*C. c.*	*Ounces.*	*Ounces.*
85	294	706	10.4	24.9
86	291	709	10.3	25.0
87	287	713	10.2	25.1
88	284	716	10.1	25.2
89	281	719	9.9	25.4
90	278	722	9.8	25.5
91	275	725	9.7	25.6
92	272	728	9.6	25.7
93	269	731	9.5	25.8
94	266	734	9.4	25.9
95	263	737	9.3	26.0
96	260	740	9.2	26.1
97	258	742	9.1	26.2
98	255	745	9.0	26.3
99	252	748	8.9	26.4
100	250	750	8.8	26.5

Proportions and Manner of Mixing the Ingredients.

The best results are obtained when the oil, rosin, and alkali solution are mixed in the following proportions and according to the following directions:

	Metric.	Avoirdupois (by weight).
	Grams.	*Ounces.*
Pine oil	1,000	35.3
Rosin	400	14.2
25 per cent NaOH solution	200	7.1

This will make approximately 1,500 cubic centimeters or 1.6 quarts of disinfectant.

The pine oil and rosin are heated together in a covered "enameled ware" pail until the rosin is all dissolved. The mixture is cooled to 80° C., the sodium hydroxid solution added, and the liquid violently stirred or "beaten" for at least 10 minutes with a rotary "Dover" egg beater. Sufficient water is added to make mixture to the original weight. The preparation is then cooled quickly by placing the pail in cold water. It is stored in glass or metal containers till used.

The finished disinfectant.—The finished disinfectant is a dark reddish-brown liquid, rather thick and oily in appearance and free from turbidity or cloudiness. It makes a perfectly white emulsion, much resembling milk when added to water. If the dilution water is at a temperature of less than 30° C. the emulsion will last for weeks. If hot water is used, a layer of oil eventually forms on the surface. The germicidal power of the disinfectant remains practically constant for about two months. After that, a noticeable deterioration occurs. Samples four months' old show a phenol coefficient of about 3.5. The pine oil itself is more stable than the emulsified product. It is well to buy only a few months' supply of the oil at a time, and to make up only enough disinfectant for a month's use.

Uses.—This disinfectant may be used wherever the ordinary coal-tar compounds are used. It has a much more pleasing odor than the coal-tar compounds, and can be used where these products, on account of their odor, are not practical. It will not attack fabrics or metals and is recommended for the disinfection of all articles used in the care of contagious diseases. It has not a displeasing taste, and has been used with success as an antiseptic throat spray and tooth and mouth wash.

It can be used in any dilution up to 1:500. The most economic strength depends wholly on the length of time it is allowed to act.

Cost.—The market quotation on pine oil is approximately 35 cents per gallon. Two of the manufacturers of the oil have quoted prices on this special fraction at from 40 to 50 cents per gallon.

"Good, strained, North Carolina, grade E" rosin is quoted at $2\frac{1}{2}$ cents per pound.

Ninety-five per cent sodium hydroxid can be bought in 10-pound drums, at $3\frac{11}{20}$ cents per pound.

One gallon of pine oil weighs approximately 3,560 grams. Upon this basis 1 gallon of disinfectant can be made with the following amounts of the ingredients and at the prices stated:

	Cents.
Pine oil, 2,500 grams, or 5.5 pounds	35
Rosin, 1,000 grams, or 2.2 pounds	5.5
25 per cent NaOH solution by weight, 500 grams, or 1.1 pounds	1
Total, 1 gallon	41.5

This price does not include cost for heat or labor, but the compounding is so simple and takes so little heat that the total cost will not exceed 50 cents per gallon.

Efficiency.—The germicidal efficiency of the preparation depends in part upon the character of the pine oil used and in part upon the minor details of compounding. These latter can not be discussed fully in this brief report. They do not affect the practical result.

Two sample batches made up by these specifications gave the following hygienic laboratory phenol coefficient, when tested by the official method without organic matter:

Hygienic Laboratory phenol coefficient.

B. TYPHOSUS 20°.

Dilution.	Time of exposure, minutes.						Phenol coefficient.
	2.5	5	7.5	10	12.5	15	
Phenol:							
80	−	−	−	−	−	−	
90	+	−	−	−	−	−	
100	+	+	+	−	−	−	
110	+	+	+	+	+	+	
120	+	+	+	+	+	+	
Pine-oil disinfectant:							
375	−	−	−	−	−	−	$\dfrac{\frac{400}{80}+\frac{450}{100}}{2}=4.75$
400	−	−	−	−	−	−	
450	+	+	+	−	−	−	
500	+	+	+	+	+	+	
550	+	+	+	+	+	+	
Pine-oil disinfectant:							
350	−	−	−	−	−	−	$\dfrac{\frac{350}{80}+\frac{450}{100}}{2}=4.44$
375	+	−	−	−	−	−	
400	+	−	−	−	−	−	
450	+	+	+	+	+	−	
500	+	+	+	+	+	+	
550	+	+	+	+	+	+	

Designation.—It is suggested that this preparation be referred to in specifications and elsewhere as the "Hygienic Laboratory pine-oil disinfectant."

PLAGUE-PREVENTION WORK.

CALIFORNIA.

The following reports of plague-prevention work in California were received from Senior Surg. Pierce, of the United States Public Health Service, in charge of the work:

WEEK ENDED SEPT. 4, 1915.

SAN FRANCISCO, CAL.

RAT PROOFING.

New buildings:	
Inspections of work under construction	85
Basements concreted (8,575 square feet)	20
Floors concreted (10,207 square feet)	4
Yards, passageways, etc., (4,383 square feet)	14
Total area of concrete laid (square feet)	23,165
Class A, B, and C (fire proof) buildings:	
Inspections made	195
Roof and basement ventilators, etc., screened	4,115
Wire screening used (square feet)	22,600
Openings around pipes, etc., closed with cement	2,761
Sidewalk lens lights replaced	1,100

SAN FRANCISCO, CAL.—Continued.

RAT PROOFING—continued.

Old buildings:	
Inspections made	248
Wooden floors removed	23
Yards and passageways, planking removed	13
Cubic feet new foundation walls installed	2,370
Concrete floors installed (24,022 square feet)	15
Basements concreted (45,190 square feet)	19
Yards and passageways, etc., concreted (6,219 square feet)	15
Total area concrete laid (square feet)	75,431
Floors rat proofed with wire cloth (8,500 square feet)	8
Buildings razed	8